



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/NO92/00065</p> <p>(22) International Filing Date: 8 April 1992 (08.04.92)</p> <p>(30) Priority data: 911425 11 April 1991 (11.04.91) NO</p> <p>(71)(72) Applicant and Inventor: HEGGERTVEIT, Fredrik [NO/NO]; Oscar Hansens vei 7, N-6400 Molde (NO).</p> <p>(74) Agent: COWARD, Bjarne, Gorgus; Bryns Patentkontor A/S, P.O. Box 9566, Egertorget, N-0128 Oslo (NO).</p> <p>(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US.</p>		<p>Published <i>With international search report.</i></p>	
<p>(54) Title: SEPARATOR FOR AT LEAST TWO SUBSTANCES HAVING DIFFERENT DENSITIES, AT LEAST ONE OF WHICH IS A LIQUID</p> <p>(57) Abstract</p> <p>A liquid separator for separation of a mixture of at least two substances having different densities, at least one of which substance is a liquid, comprising a preferably cylindrical housing (7) having a tangential inlet (2) at the upper end and an outlet (12) at the lower end thereof, that there are centrally disposed within the housing a plurality of vertically spaced plate members (3) having the form of a truncated cone with the open vertex oriented upward, and that the vertex (4) of the uppermost plate member is connected to a transport line (5). The housing (7) has between the inlet (2) and outlet (12) thereof at least one annular expanded area (9) provided with one or more current generators (13).</p>			

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SEPARATOR FOR AT LEAST TWO SUBSTANCES HAVING DIFFERENT DENSITIES, AT LEAST ONE OF WHICH IS A LIQUID.

5 The present invention relates to a liquid separator and particularly a separator for separating a liquid having low density from water. It is not limited to liquids only, as it will also separate out substances and particles that have low density in relation to water.
10

In connection with increased oil extraction offshore, and increasing transport of oil by ship, there is a steadily growing risk of oil spills into the water. To collect up oil
15 from water, the oil must first be concentrated and confined, and this is normally done with the aid of oil booms. Then,
known equipment such as skimmers, mops, etc., is used to
transport oil mixed with water from this enclosure to the
collection site. The mixture may then be subjected to
20 further separation as required, in accordance with several
known methods. There exist a number of separator systems
with a high degree of efficiency for oil/water of both high
and low concentrations. Several of the systems, which are
25 sensitive with regard to solid matter, are based on high
technology, are costly, and are poorly suited for the first
phase of separation of oil from water in major oil spills.
The present invention is based on new principles, is robust
30 and is not particularly vulnerable to solid matter. It
would be capable of separating oil from water in both large
and small concentrations, and is therefore not dependent on
oil booms for concentrating the oil prior to collection. The
separator may placed conveniently in ships which draw in
large amounts of water mixed with oil without major preparation
35 as with use of booms, skimmers, etc.

35 The purpose of the present invention is to provide a separator having excellent separation properties for two or

more substances of different densities, at least one of which is a liquid, where the concentration of one of the liquids is very small, for example, in cases of major oil spills at sea.

This is achieved with a separation assembly according to the invention consisting of a preferably cylindrical housing having a tangential inlet at the upper end and an outlet at the lower end thereof, where there are centrally disposed within the housing a plurality of vertically spaced plate members in the form of a truncated cone with the open vertex oriented upward; the uppermost plate member being connected to a transport line for the liquid having lowest density. The invention is also characterized in that the housing is provided, between the inlet and the outlet thereof, with at least one annular expanded area provided with one or more current generators.

A preferred embodiment form of the invention will now be described in more detail with reference to the accompanying drawings.

Fig. 1 shows a vertical section through a separator in accordance with the invention, seen from the side.

Fig. 2 shows a horizontal section through the separator along line A-A in Fig. 1.

Fig. 3 shows a horizontal section through the separator along line B-B in Fig. 1.

Fig. 4 shows a horizontal section through the separator along line C-C in Fig. 1.

Figure 1 shows a section through the separator consisting of a top plate 2, a cylinder 7, which is encircled by a larger annular channel 9 and the bottom 12. In the center of the separator are mounted a plurality of truncated conical plates

3, which expediently are fastened to the main structure of the separator. The diameter of the conical plates 3 is somewhat smaller than the interior diameter of cylinder 7. Within the annular channel 9 is mounted a current generator 13 (shown here as a propeller), which is driven by motor 15. The channel 9 is additionally provided with suitable current stabilizers 14, according to need.

The mixture, preferably oil and water, enters tangentially at the top of the separator at 1 so as to be set into rotation within the separator's cylinder 7. The mixture then flows down along the walls of cylinder 7. Due to the action of centrifugal force on the mixture as a consequence of the rotation, the liquid having lowest density (oil) will be drawn in toward the center of cylinder 7, while the liquid having greatest density (water) will be cast out toward the walls of cylinder 7. The velocity of the mixture will decline toward the center of the cylinder, so that when the oil particles are drawn inward and come under the edge of a cone 3, the rate of rotation will be further decreased due to the friction against the cone, at the same time as the oil particles will have a better opportunity to float upward. When an oil particle has entered the area beneath cone 3, there are no forces to draw it outward again, and the oil is trapped. The oil particles float upward and collect underneath the uppermost cone 4, wherefrom the oil 6 is pumped out of the separator via transport line 5.

The separation takes place continuously, whilst the mixture sinks down through the separator toward the outlet 11. The current generator driven by motor 15 accelerates the mixture 10 when it arrives at channel 9. This substantially increases the separation effect. Acceleration channel 9 is an expedient feature for two reasons. It reduces the need to have a very high separator for treatment of a specific mixture in order 35 to achieve satisfactory separation; it cuts down the required separation height by virtue of the increasing velocity.

Motor 15 may have a varying speed, thereby enabling the regulation of the acceleration of the mixture. This is an essential feature of the invention, as it makes possible the adaptation of the separation effect both in accordance with the amount of mixture introduced into the separator, and in situations where it is difficult to achieve a satisfactory separation.

Although the present invention is described with reference to a specific embodiment form, it is self-evident that a person skilled in the art may make changes and modifications without deviating from the scope of protection for the invention. Such modifications may entail, for example, substantially changing the length 3 of the cylinder, or utilizing more or fewer acceleration channels 9. There may also be used other types of current generators than the one that is shown here.

P a t e n t C l a i m s

1.

, A separator assembly for a mixture of at least two substances having different densities, at least one of which substance is a liquid, which assembly comprises a preferably cylindrical housing (7) having an outlet (12) at the lower end thereof, a plurality of vertically spaced plate members (3) having the form of a truncated cone with the open vertex oriented upward, and wherein the vertex (4) of the uppermost member is connected to a transport line (5),
10 characterized in that the inlet (2) in the upper end is placed tangentially.

15

2.

The assembly according to claim 1, characterized in that the housing (7) between the inlet (2) and outlet (12) has at least one annular expanded area (9) provided with
20 one or more current generators (13).

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1/2

FIG.1

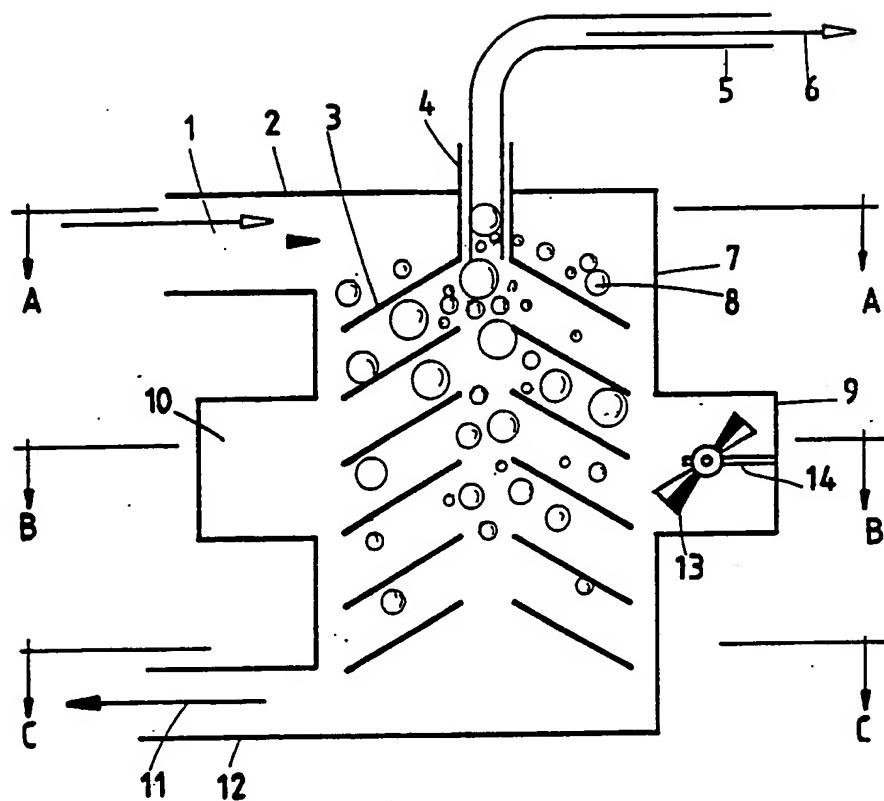
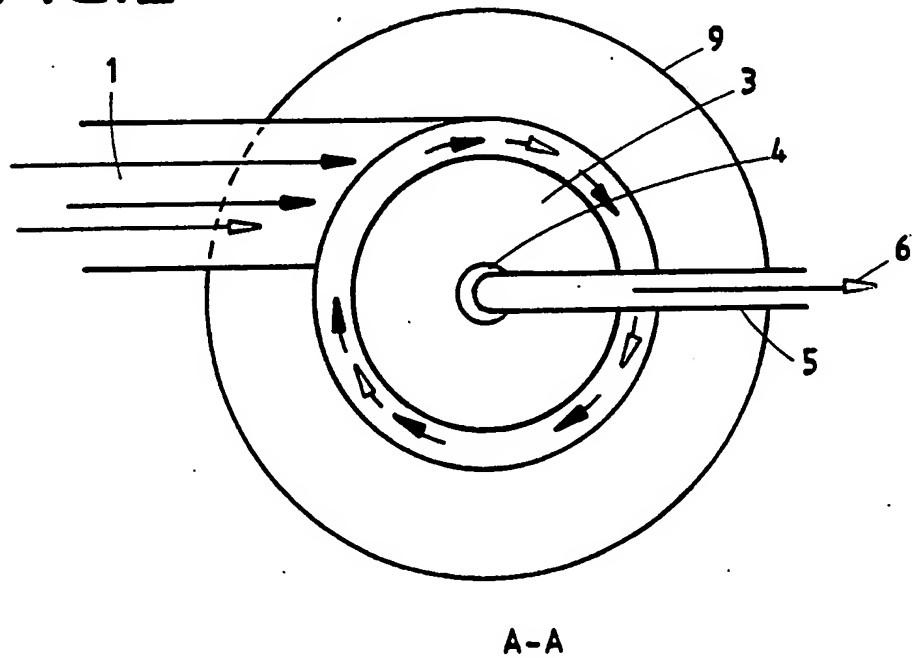


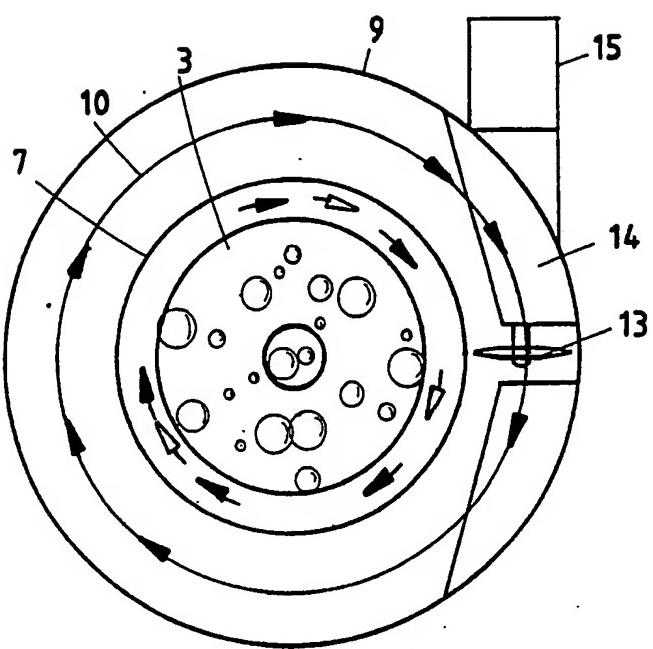
FIG.2



A-A

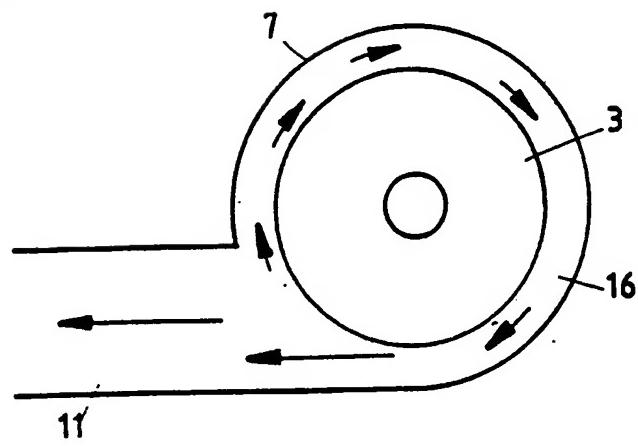
2/2

FIG.3



B-B

FIG.4



C-C

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00065

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC
IPC5: B 01 D 17/038

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
IPC5	B 01 D

Documentation Searched other than Minimum Documentation
 to the Extent that such Documents are Included in Fields Searched⁸

SE,DK,FI,NO classes as above

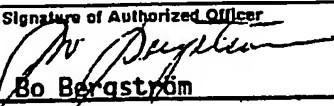
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	DE, A1, 2507190 (BOLL & KIRCH FILTERBAU GMBH) 2 September 1976, see figure 1; claim 1 --	1
Y	SE, C, 116439 (AKTIEBOLAGET SEPARATOR) 28 May 1946, see figure 1 --	1
A	DE, C2, 2453555 (SOCIÉTÉ GÉNÉRALE DE CONSTRUCTIONS ELECTRIQUES ET MÉCANIQUES ET AL) 17 February 1983, see figure 1 --	2
A	US, A, 1709971 (HARRISON S. COE) 23 April 1929, see figure 3 --	1

* Special categories of cited documents:¹⁰

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15th July 1992	1992 -07- 20
International Searching Authority	Signature of Authorized Officer  Bo Bergström

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	Derwent's abstract, No. 84- 73 001/12, SU 1 018 680, publ. week 8412 -----	1

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/NO 92/00065**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on **29/05/92**.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A1- 2507190	76-09-02	NONE	
SE-C- 116439	46-05-28	NONE	
DE-C2- 2453555	83-02-17	BE-A- 821371 CA-A- 1046949 CH-A- 584051 FR-A-B- 2250557 GB-A- 1475760 JP-C- 1092969 JP-A- 50083859 JP-B- 56036962 NL-A- 7414634 OA-A- 4840 US-A- 3915858	75-04-23 79-01-23 77-01-31 75-06-06 77-06-10 82-04-16 75-07-07 81-08-27 75-05-16 80-10-31 75-10-28
US-A- 1709971	29-04-23	NONE	